



Use of Guided Long Wave
Ultrasonic Inspection for Anomaly
Locating and Use of Composite
Repair Materials

What We'll Talk About Today

- Introduction of team
- The M-2 oil pipeline
- Internal "Smart Pig" inspection
- GUL inspection
- Composite repair technology

Team Members

- Venoco – Rob Campbell-Taylor
(now with Graveyard Winery)
- DTS – Rick Seaver
- SPEC Services – Omar Estrada
- Armor-Plate – Tony Wilson

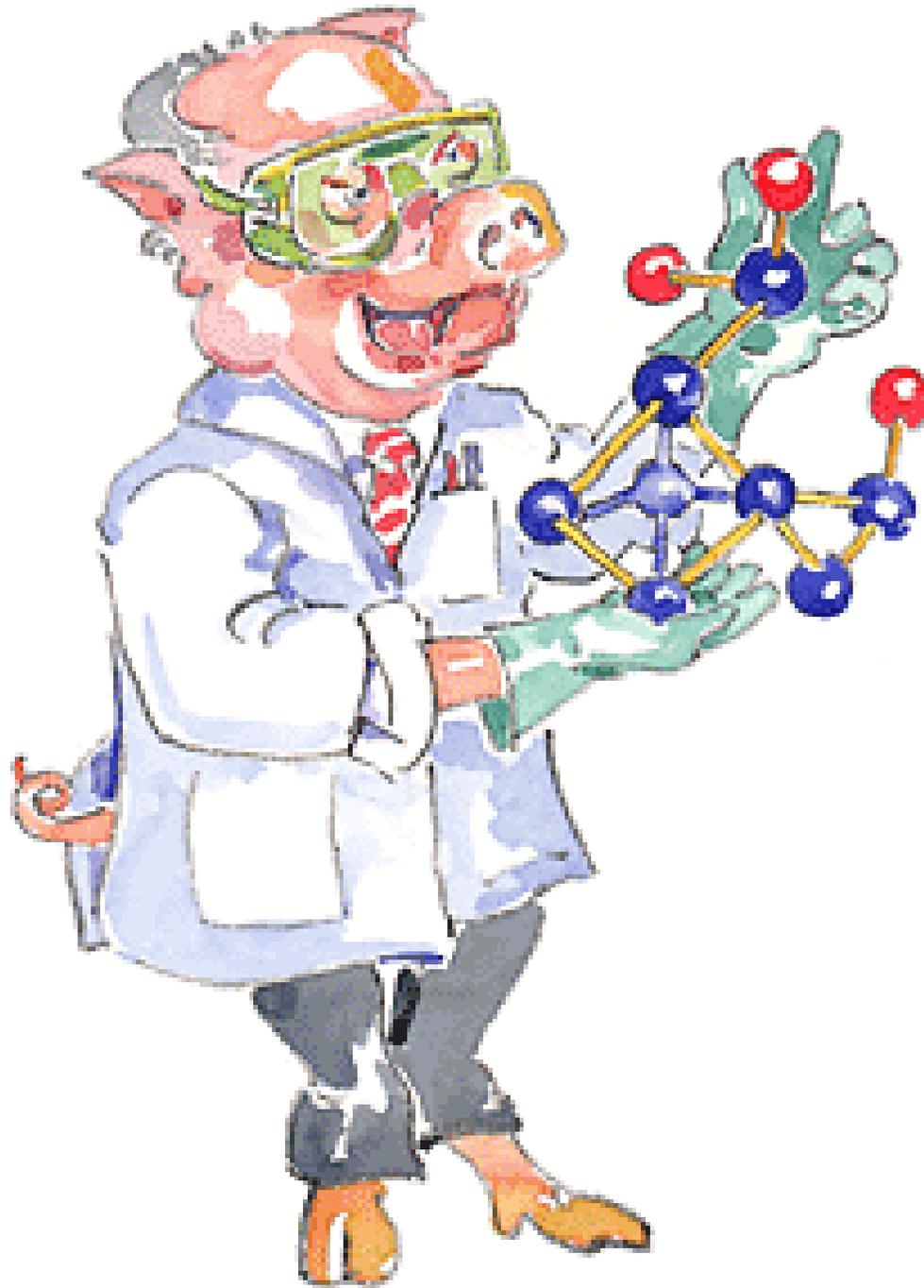


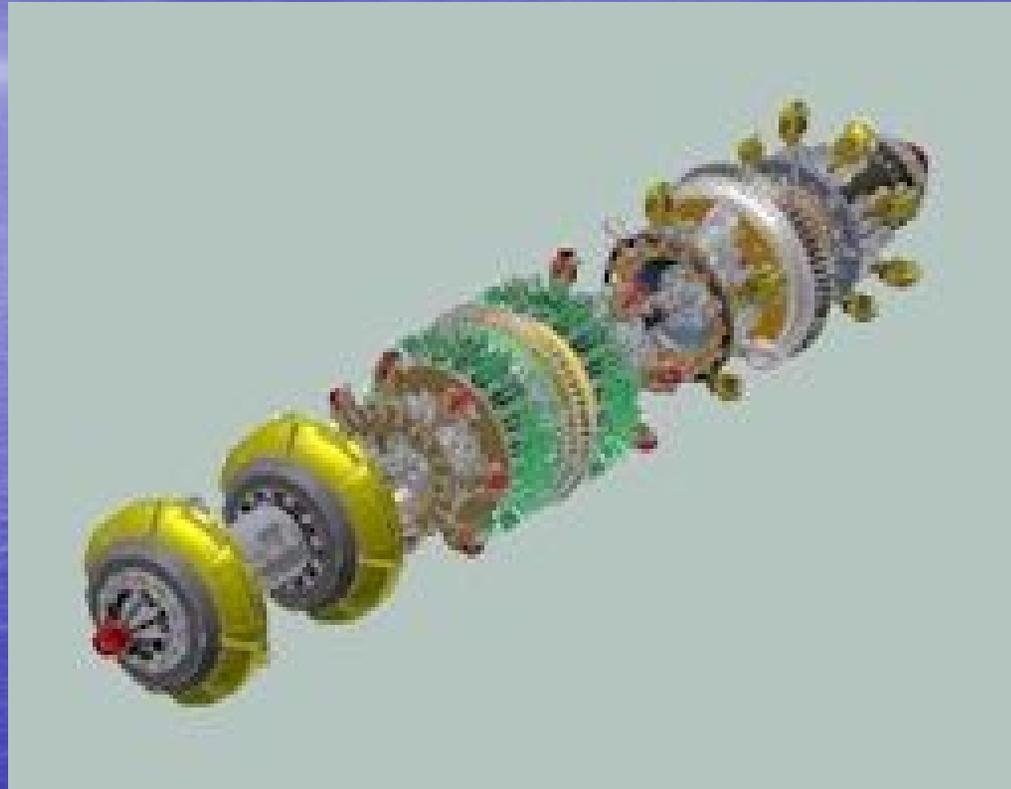
12" x 10" M-2 Oil Pipeline

- Carries crude oil from Platforms Gail/Grace to shore
- 10.750 OD, 0.375 WT, A53 Gr. B (35,000 psi yield)
 - ANSI 300# Flanges (MAOP 740 psig)
 - Design Pressure 1,426 psig
- Operates 24 hrs/day, 365 days per year

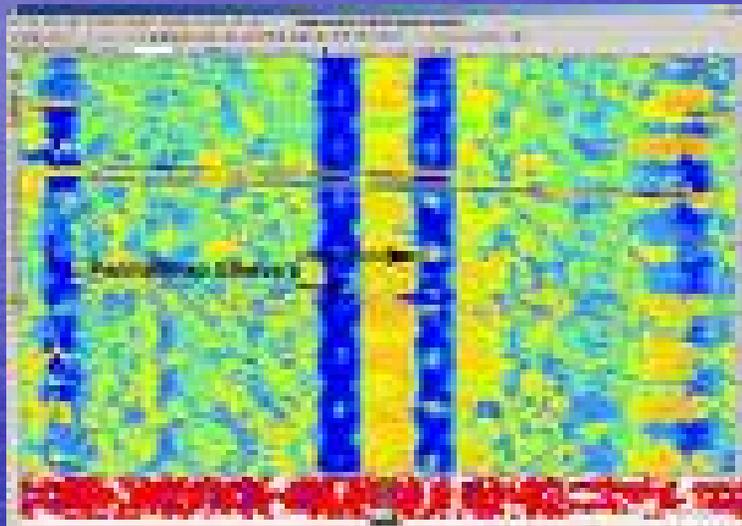
Internal "Smart Pig" Findings

The background of the slide is a solid blue color with a subtle, repeating pattern of water ripples. The ripples are most visible in the lower half of the image, creating a textured effect. The overall color is a deep, slightly darker blue, with some lighter blue highlights near the top, suggesting a sky or horizon line.









Internal "Smart Pig" Findings

- Line routinely inspected on a bi-annual basis
- January 2004 results indicated potential anomalies
 - Up to 53% wall loss
 - Over 134.5" in length
- Findings plotted on maps

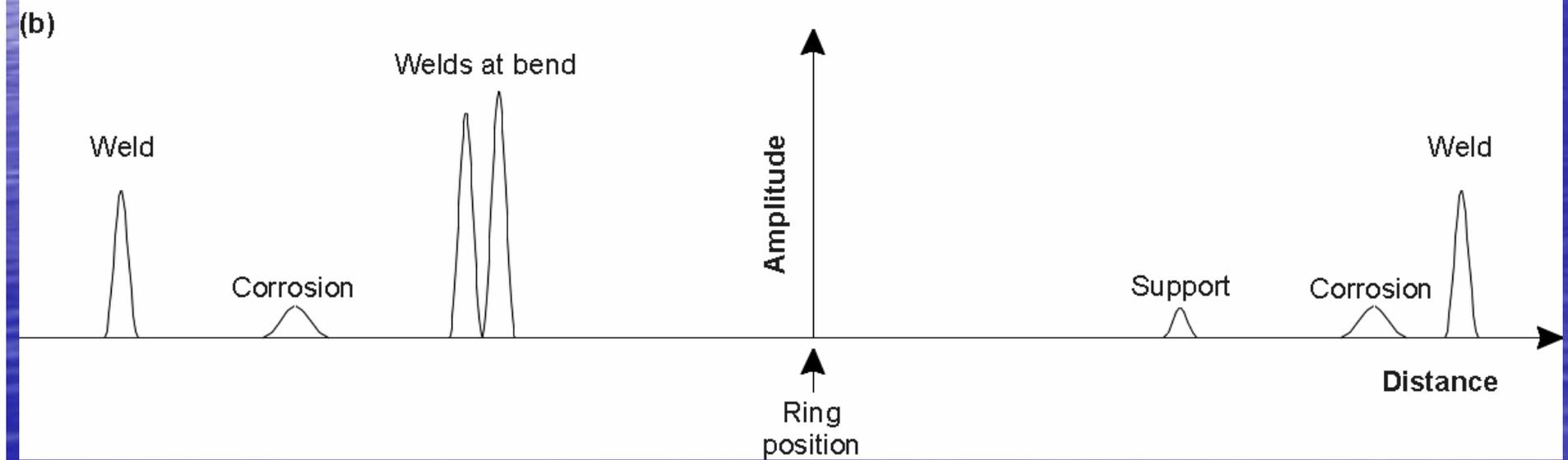
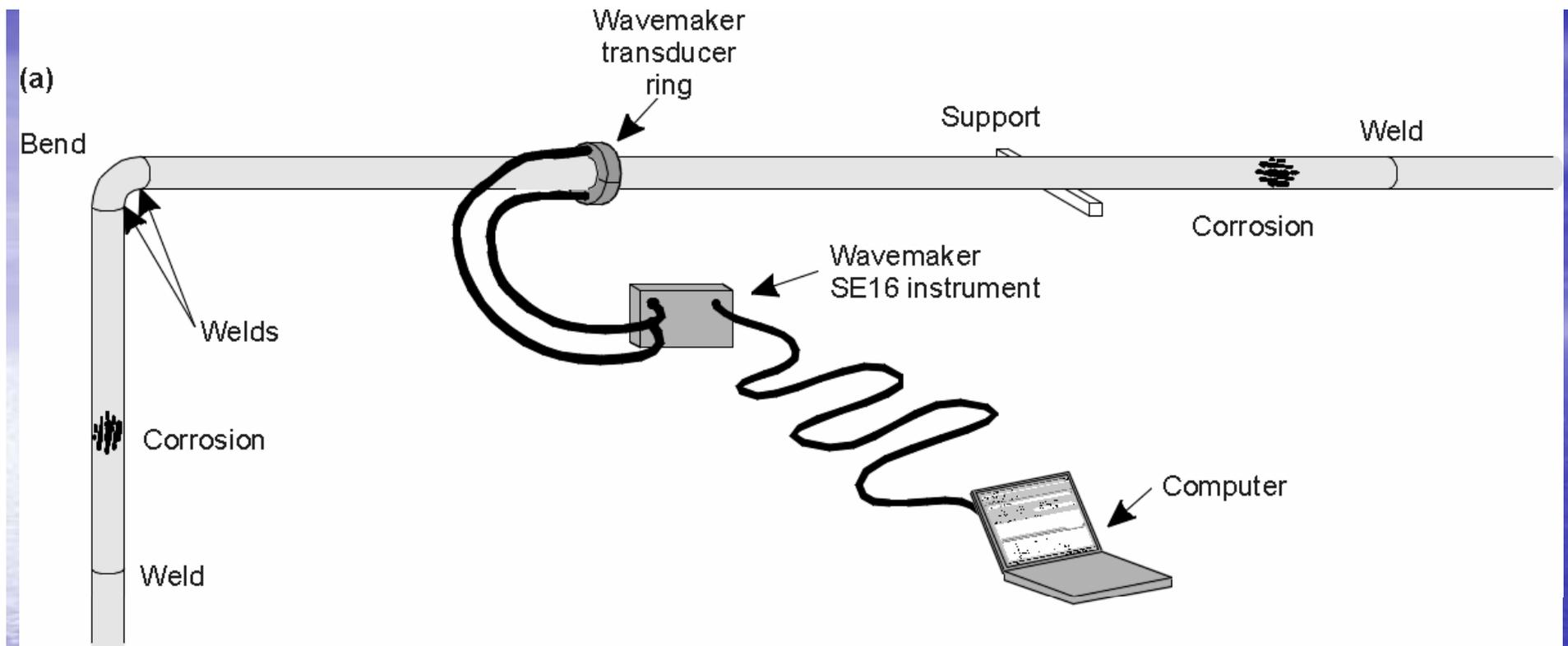
Internal "Smart Pig" Findings

- ANSI B31.G calculations resulted in de-rate of line to 613 psi
- Uncertainty over actual wall loss
- Uncertainty over location
 - Wheel Slippage
 - Lack of benchmarks offshore
 - Pipe buried under several feet of sand in fall and summer

Focused GUL Inspection

- Guided Wave Ultrasonic Inspection
June 4, 2004
 - “Shoots” ultrasonic signal down pipe and looks at reflections





Focused GUL Inspection

- Limited by miter bends, tees, coating, etc.
- In our case obtained between 300' to 700' look ahead/look back
- Was able to establish weld locations and correlate to Internal Inspection results



7.22.2004



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031306#9285



7.22.2004



7. 22. 2004



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**Shot – 89971
(Collar Location)**

This shot was made on the cliff side of the grout bag with the positive direction toward the ocean.



**Shot – 89977
(Collar Location)**

This shot was made at the cliff with the positive direction toward the cliff.



Focused GUL Inspection

- Guided Wave Ultrasonic Inspection –
June 21, 2004
 - Re-excavated beach based upon
correlated findings













Focused GUL Inspection

- Located two anomalies – external scouring of pipe





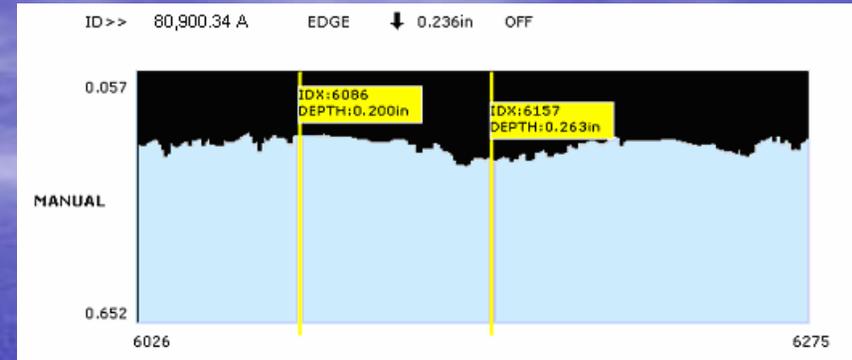
Shot – 89977 (Corrosion Location)

Feature locations were B-Scan inspected on 6-21-2004. Over 50% wall loss found at this location. This feature was found with the Smart Pig at the 80,900.34' location.

See attached B-Scan Details of this inspection



Scan – Feature 80,900.34



The remaining thickness in this area ranged from .200" to .263"

The top half of the piping was scanned to reveal a remaining thickness ranging from .200" to .263" from a nominal thickness of .375"

Focused GUL Inspection

- Hand “B-Scan” analysis carried out

Focused GUL Inspection

- Guided Wave Ultrasonic Inspection – June 21, 2004
 - Found 0.155" WT (58.6% loss) and 0.204" WT (45.6% loss)
 - Defects located within 45" of each other
 - About 12' total pipe exposed to scour
 - Subjected to RSTRENG analysis, determined true MAOP was 1188 psi, well above 740 psi

Repair Method Selection

- Restore Hoop Stress
 - Clockspring
 - Pipe repair Clamp
 - Pipe repair Sleeve
 - Composite technology – Fiberglass
- Provide additional scour protection
 - Pipe repair sleeve
 - Composite technology

Composite Repair Technology

- Armor Plate System Selected
 - Resinous Amine Compound, binary saturant and curative compounds
 - Tri-axial continuous filament fiberglass wrap
 - Able to cure under salt water

Composite Repair Technology

- Armor Plate System Selected
 - 4-layer wrap found to restore full hoop stress
 - 2-layer wrap added for scour protection and missing coating
- Contingency Planning Included Welded Sleeves as Back-Up

Project Execution

- Project Execution Plan submitted to MMS on August 5, 2004
- Protection of Habitat Was Critical
 - No Mechanized Equipment on Beach
 - No Shoring
 - Very Limited Ability to Dewater

Project Execution

- Protection of Habitat Was Critical
 - Seal Mitigation Planning



SENSITIVE HARBOR SEAL HABITAT

BEACH CLOSED

DECEMBER 1 to MAY 31

NO DOGS OR PEOPLE ON BEACH 750 FEET EITHER SIDE OF PIER

HELP PROTECT THE SEALS - STAY AWAY!

Our local Harbor Seal Colony is one of only 4 along the Southern California Coast.

Seals haul out with their young during the day and night. Adult Seals leave their young on the beach while fishing. Adults may abandon their young at the sight or smell of dogs or people.

The Federal Marine Mammal Protection Act & Carpinteria City Code CMC 12.24.090 prohibit disturbing Harbor Seals at any time.

NO DOGS or other ANIMALS ALLOWED on Carpinteria Beaches at any time.



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MIKE EDWARDS 2003

Project Execution

- Minimize any disturbance to seals
- Seal Eye Protection (Weld Arc Flash)
- Continuous observation and video logging by County Environmental Monitors



Project Execution

- Project began October 12, 2004 (Day 1)
 - Narrow late afternoon window “Slack low tide” to work in
 - Minimum 10 laborers to dig
 - Infusion of seawater was problem

Project Execution

- October 13, 2004 (Day 2)
 - Received permission to use crane-suspended dewatering pump
 - Allowed pipe to be exposed, measurements taken

Project Execution

- October 14, 2004 (Day 3)
 - Pipe Exposed
 - Defects confirmed using hand held UT tool
 - Wrap applied along 17' length















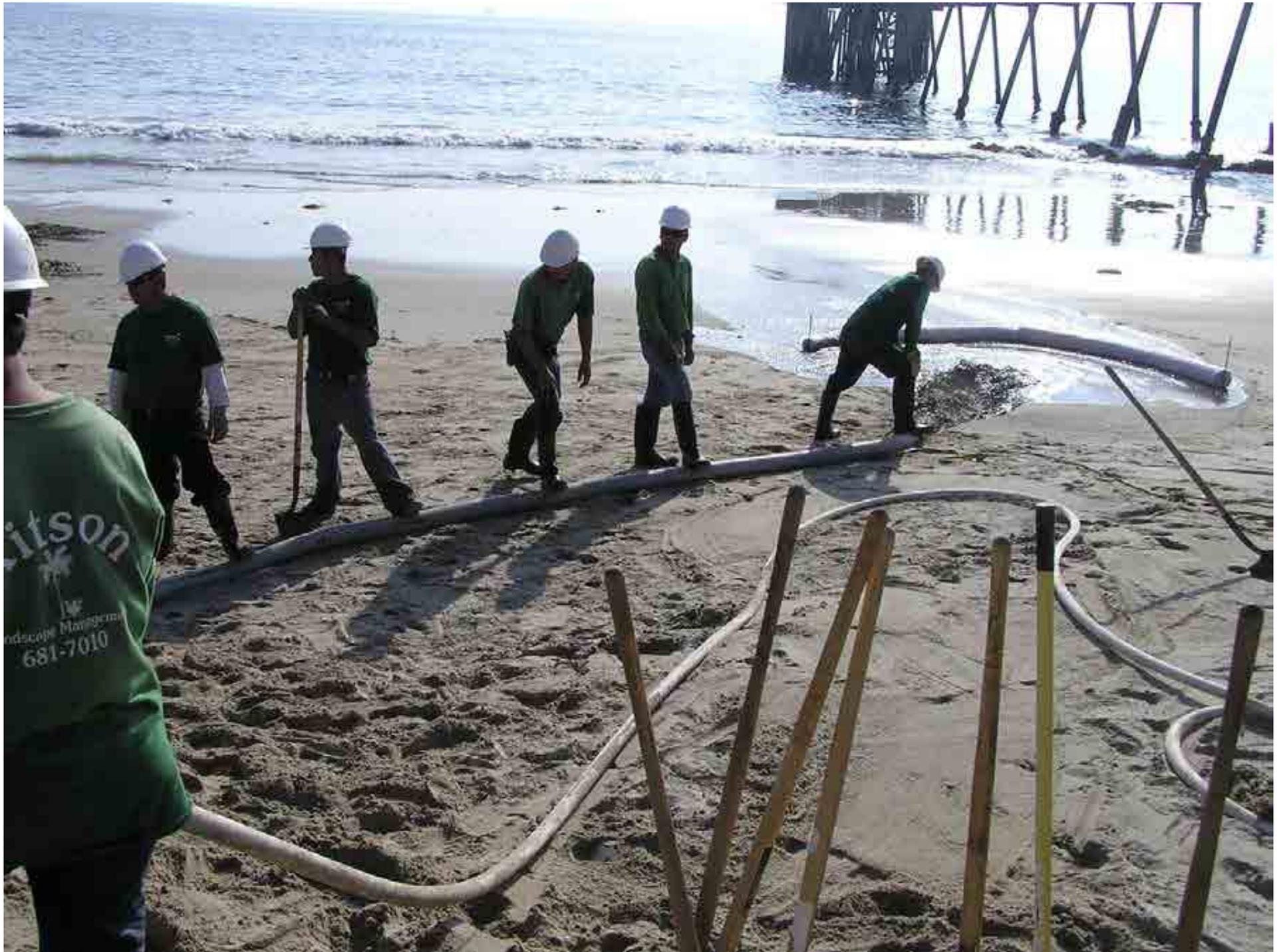




































Project Costs

- AFE funded at \$146,000
 - Engineering \$10,000
 - Wrapping System \$36,000
 - Crane \$6,000
 - Beach Labor \$15,000
 - Rental Equipment \$6,000

Project Costs

- Extras
 - Lack of Low Tide Window Limited Productivity
 - Armor Plate Needed Crew of 5 vs. 3
 - Dewatering Pump and Crane Use
 - Presence of Natural Seeps

Recap

- Based upon “Smart Pig” inspection, we knew additional investigation was warranted...
- Focused GUI Inspection was used to locate defects...
- Hand-Held B-Scan pinpointed defects and measured them...
- Composite Repair technology was used to effect repair, under challenging conditions....
- Environment was protected at all times.